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# Construction Challenges and Recent SVC Project Experience “Building an SVC on Rock”

ATC's Benson Lake SVC Project

# Presenters

- Ken Jauquet
  - Major Project Manager, ATC
  
- Derek Parker
  - Consultant Substation Project Engineer, ATC

# Today's Topics

- Introduction to ATC
- Benson Lake SVC project background
- Project Contract and Design
- Project Construction
- Questions

# Introducing ATC

- Began in 2001
- First multi-state, transmission only utility in U.S.
- Assets > \$4 billion
- 9,500+ miles of transmission line
- 500+ substations



# National leader in building transmission

**2,400+ miles**  
of transmission line  
upgraded or built

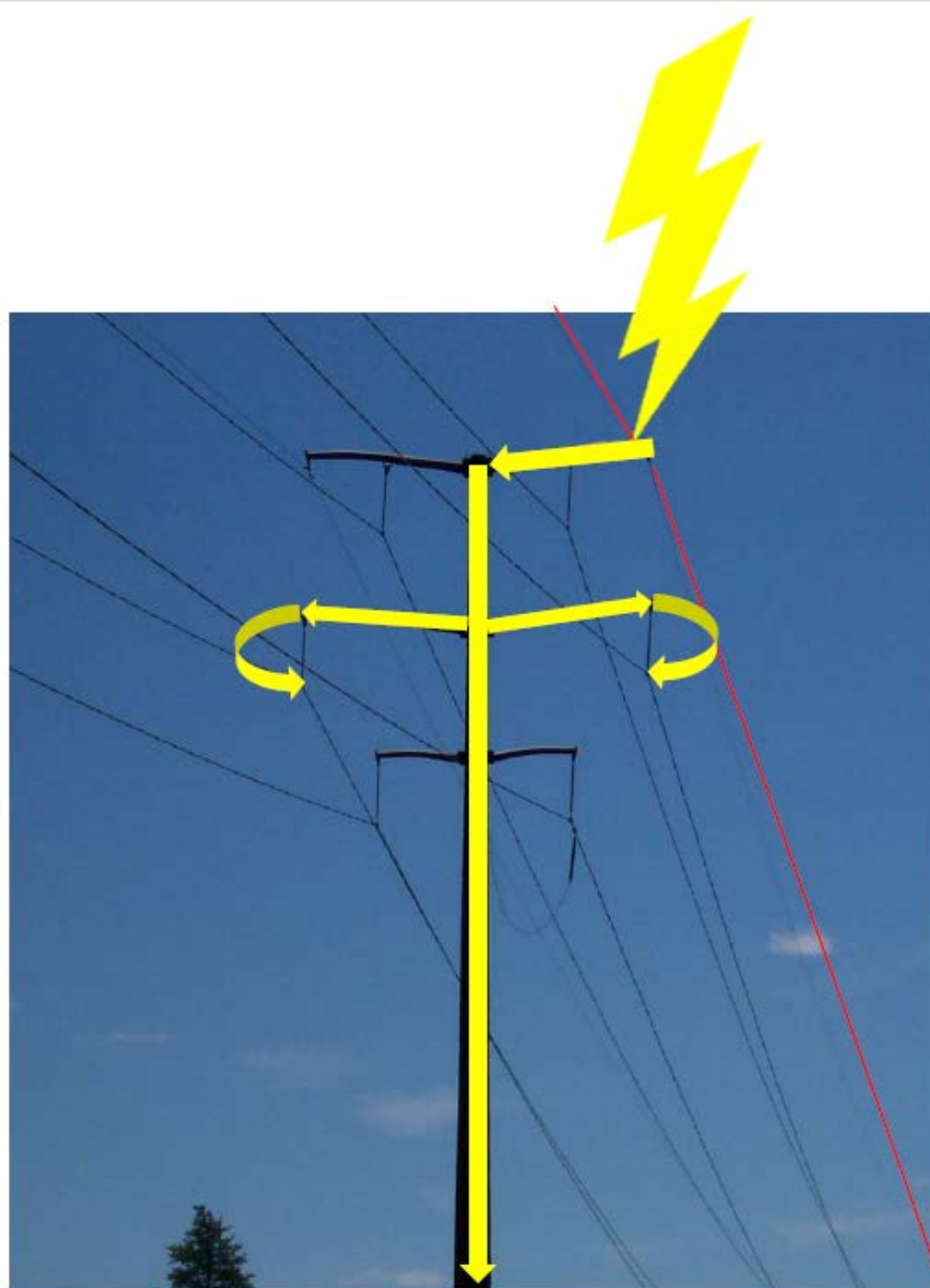
**170+ substations**  
Built or improved



# Need for Voltage support

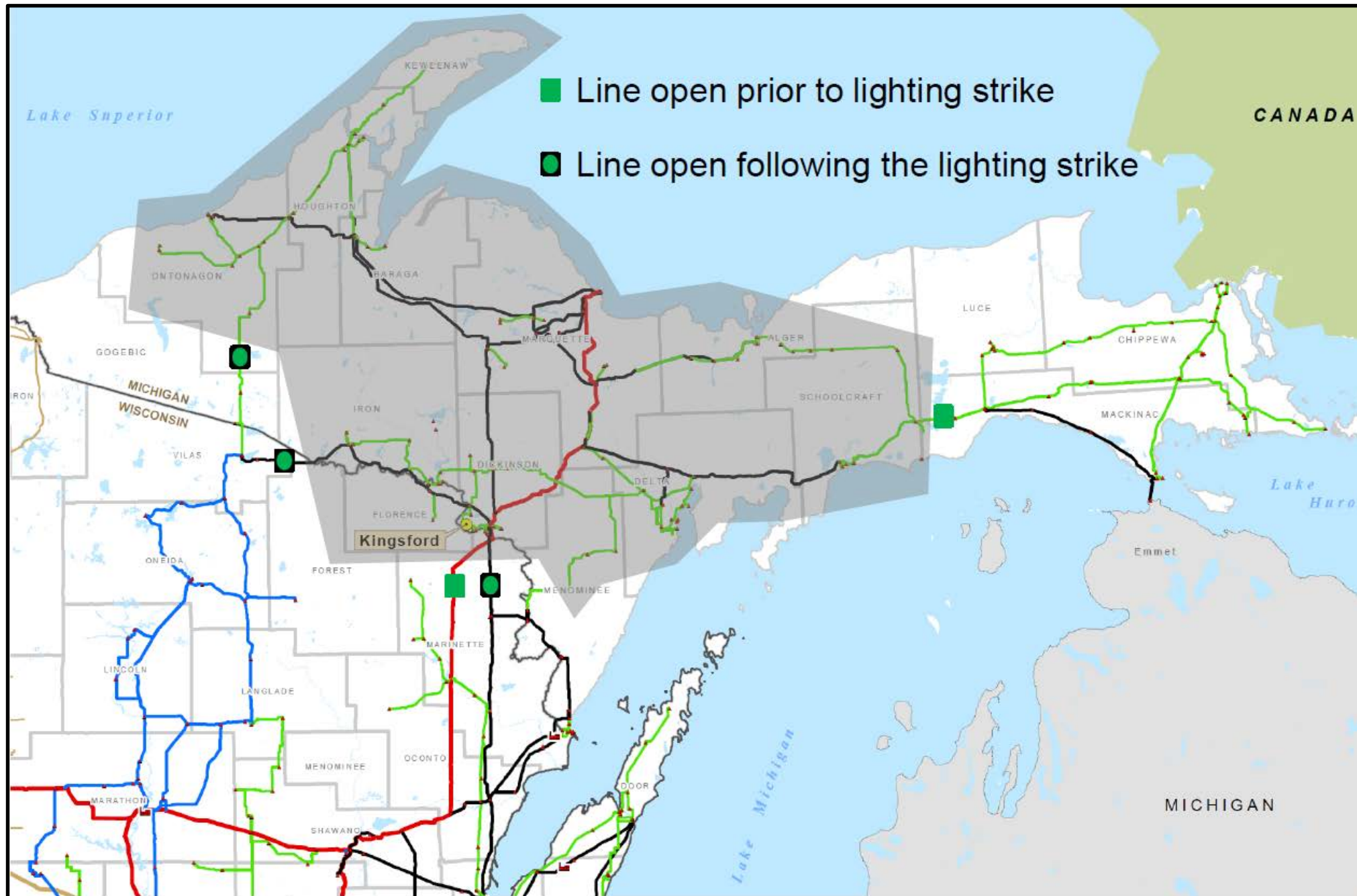
- May 10, 2011 West & Central UP Blackout
  - Planned outage of the 345-kV circuit
  - Split system configuration
    - Eastern UP (Pre- Mackinac HVDC)
  - 93 kA Lightning strike caused fault on double circuit 138-kV lines
  - Remaining 138-kV & 69-kV ties tripped within ~2.5 sec to form an island
  - My personal experience during the outage

# May 10, 2011 West & Central UP Blackout



- **Shield wire received a direct stroke of 93 kA**
- **Poor grounding causes tower to elevate in voltage**
- **Results in insulation flash-over and faults the middle phase of both circuits**
  - Arresters had been installed on the bottom phase of both lines

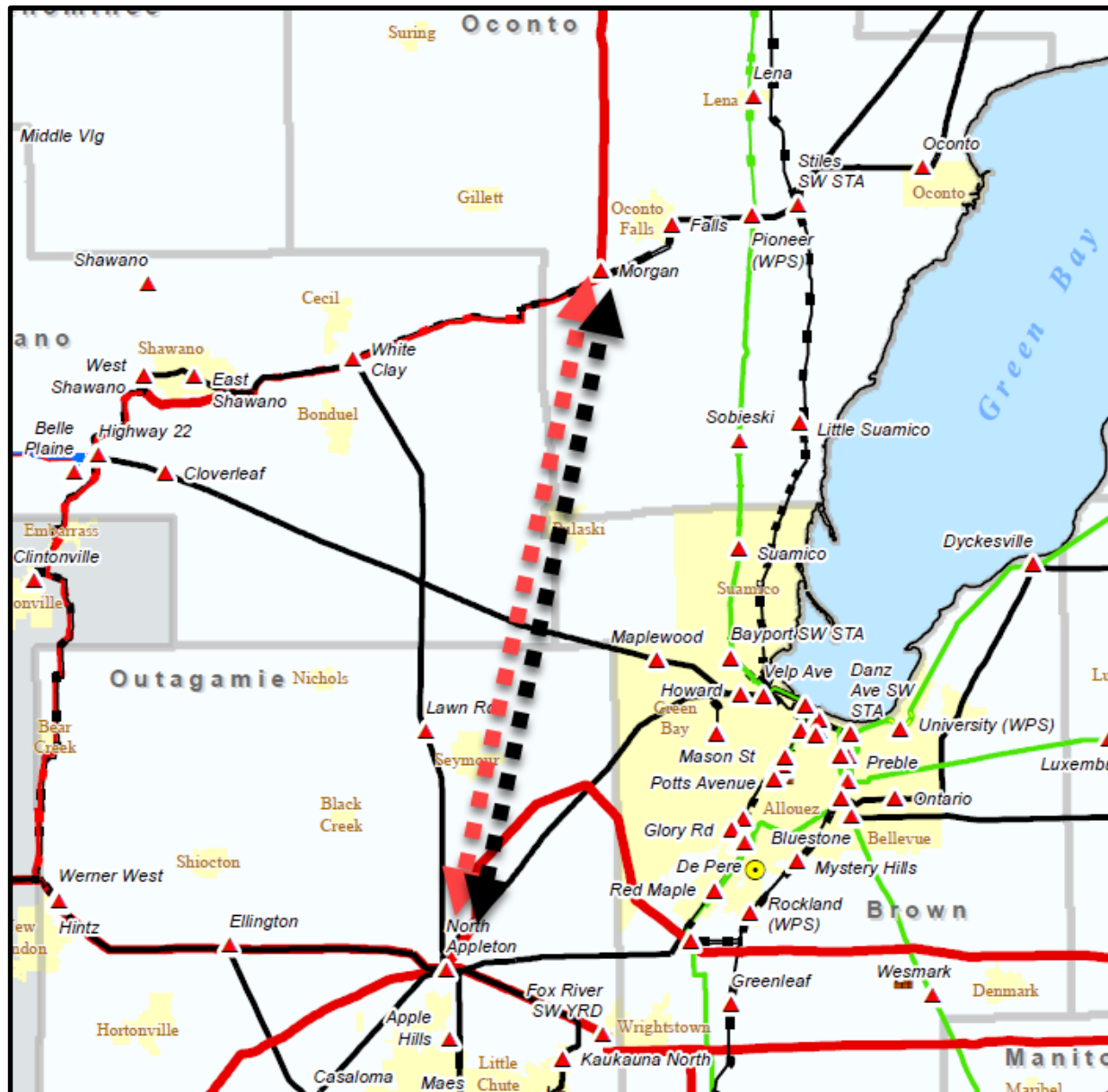
# May 10, 2011 West & Central UP Blackout



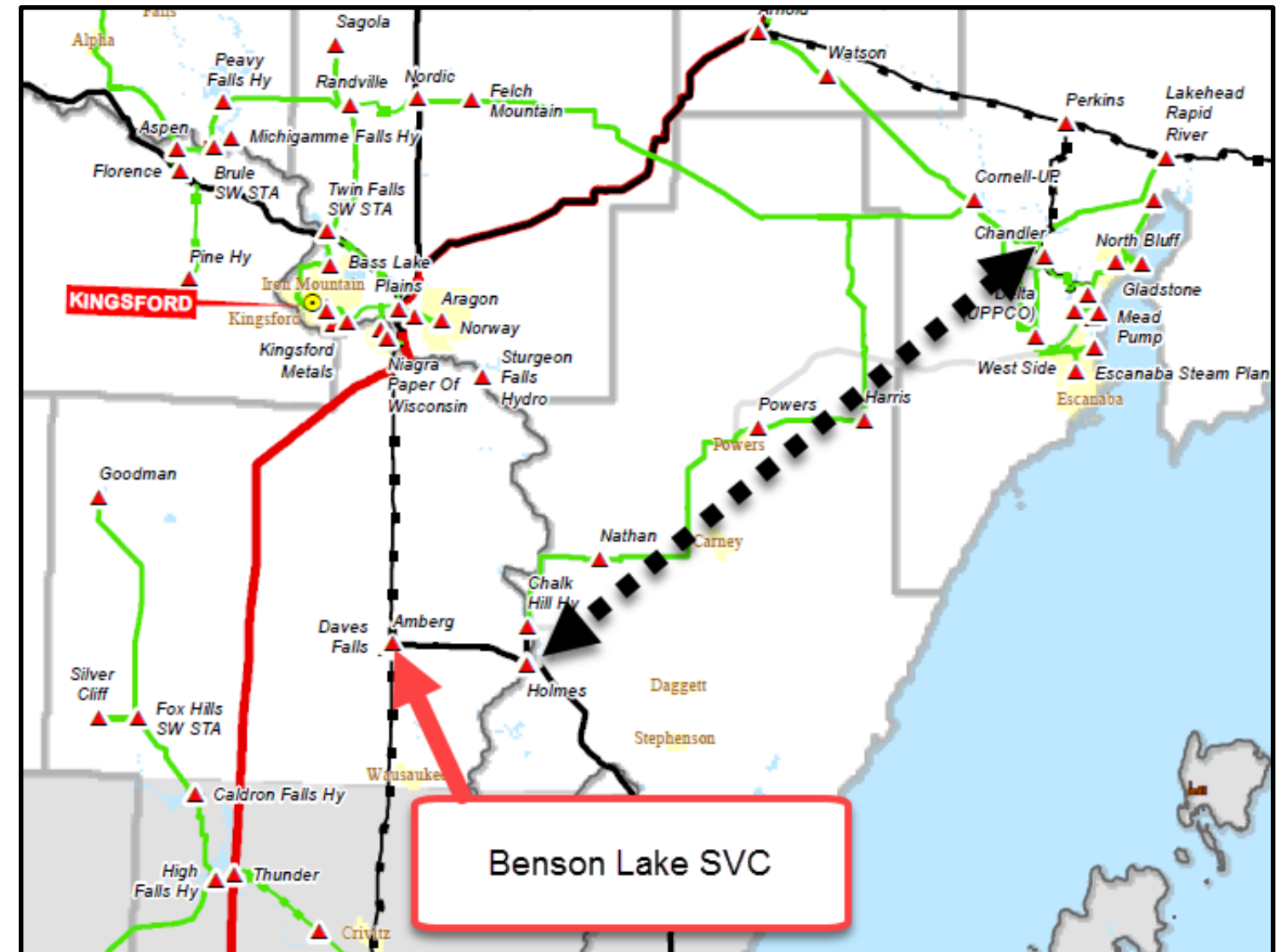


# Bay Lake Projects

New North Appleton to Morgan transmission lines

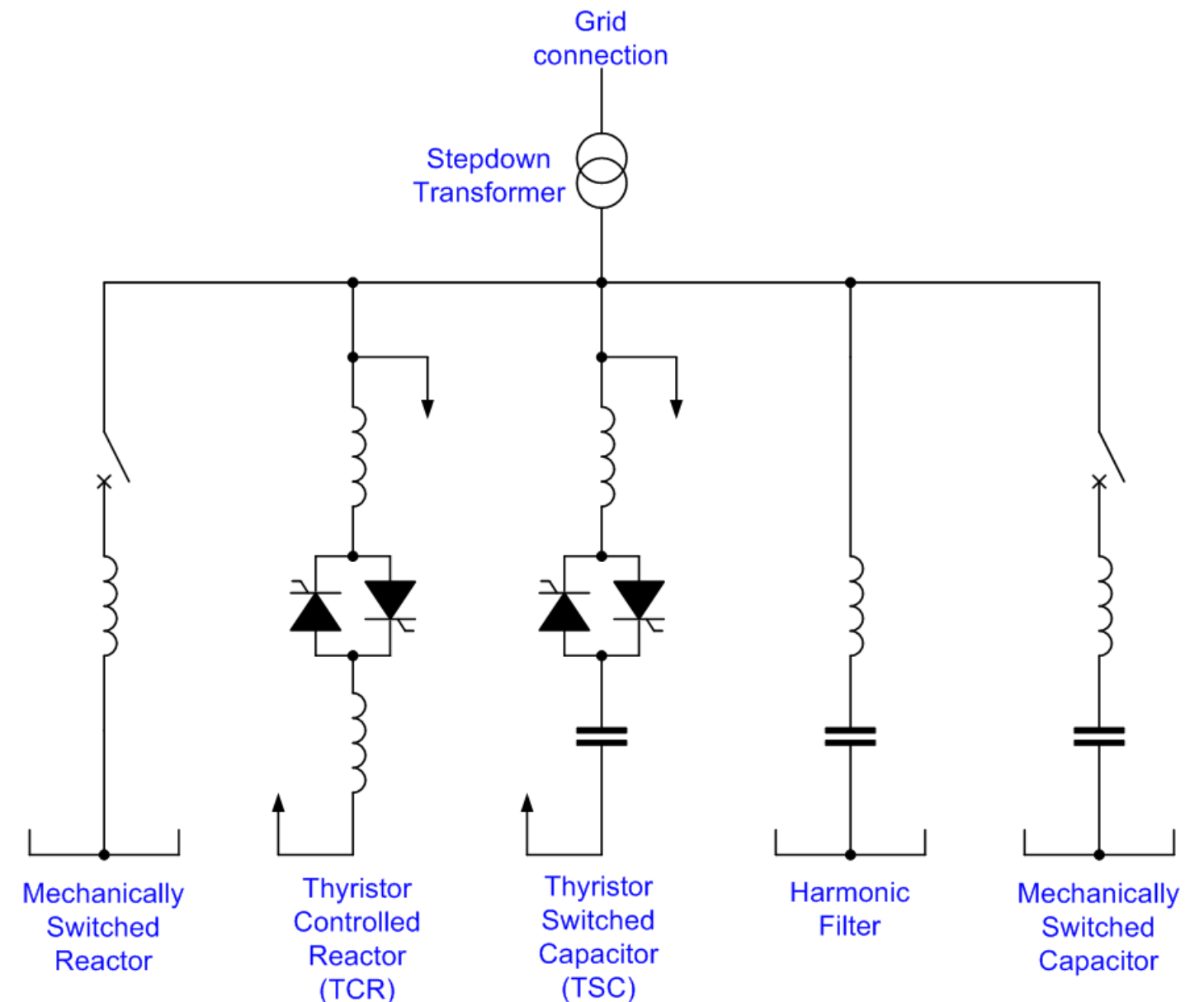


New Holmes to Old Mead Road line and **Benson Lake SVC**



# Static VAr Compensator(SVC)

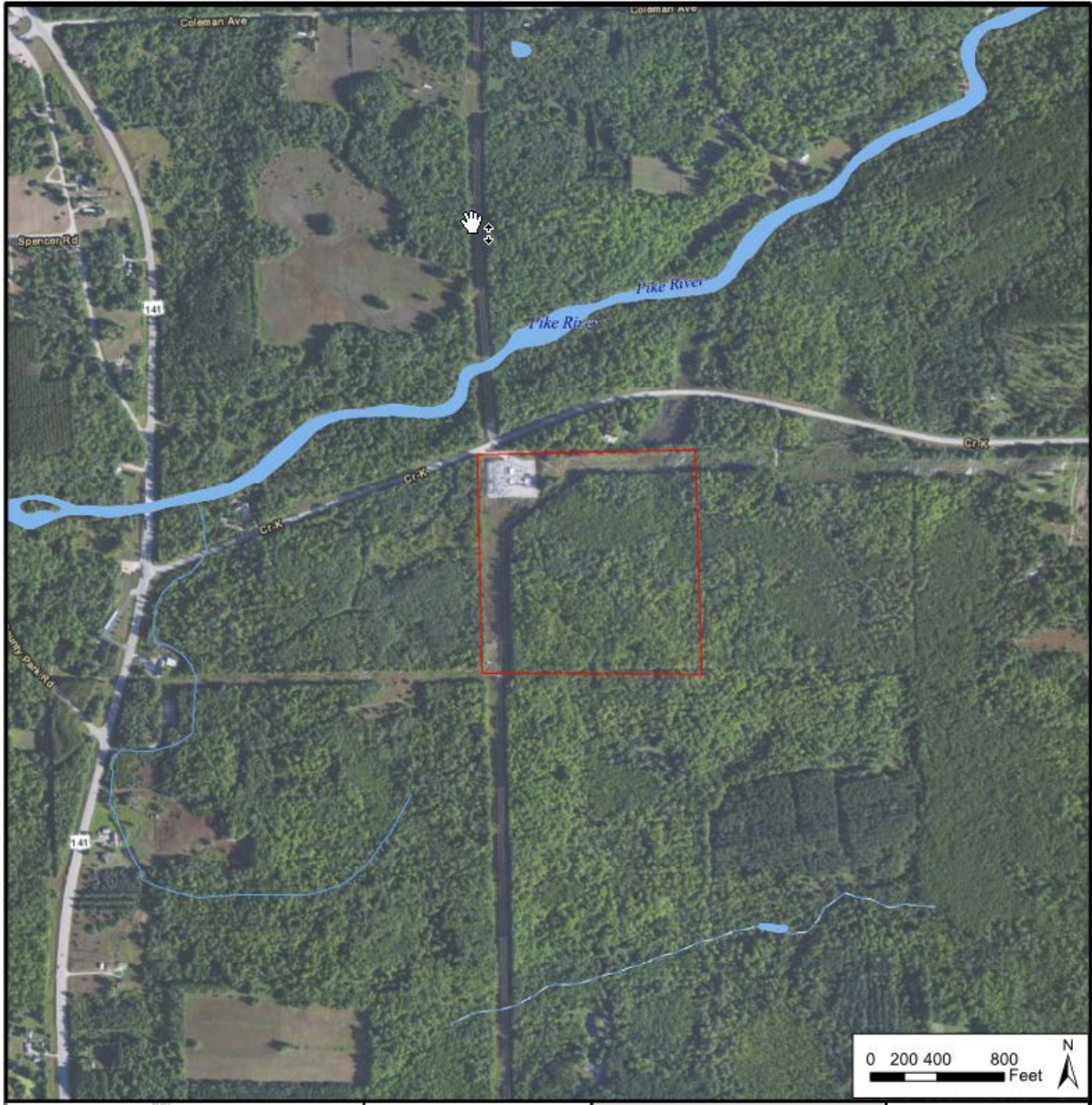
- **Static VAr Compensator** is a set of electrical devices for providing fast-acting reactive power on high-voltage electricity transmission networks. SVCs are part of the Flexible AC transmission system device family, regulating voltage, power factor, harmonics and stabilizing the system.



# SVC Development & Siting

- Amberg Substation preferred location from power flow perspective
  - Physical limitations
- Other sites evaluated but ruled out
  - Holmes Substation
  - Former distribution station
  - New network substation near Amberg Substation
- Decision made to site new SVC adjacent to Amberg Substation
  - On ATC property
  - Radial 138kV line back to Amberg Substation
  - Named “Benson Lake SVC”

# Benson Lake SVC Siting



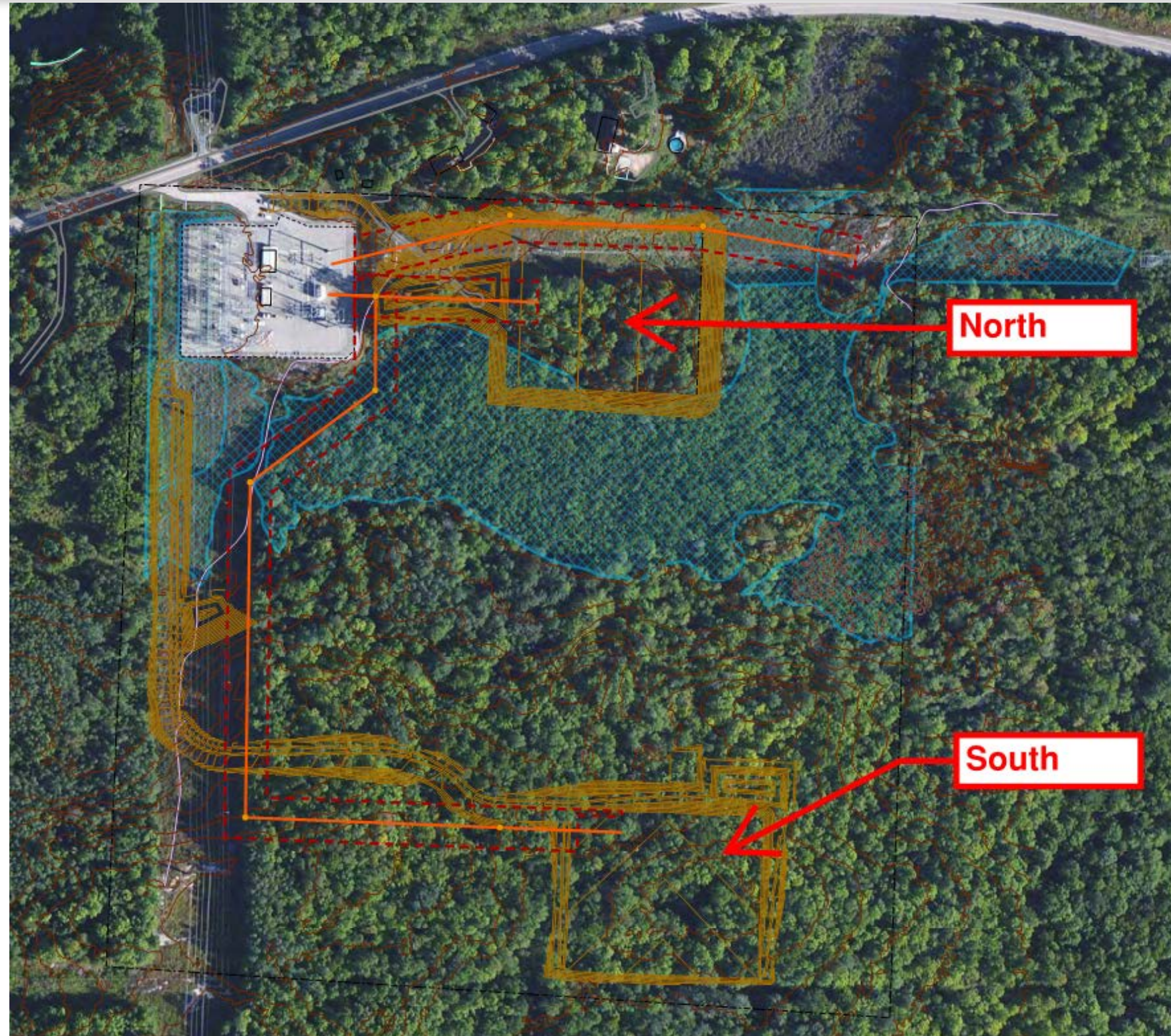
# Benson Lake SVC Siting



# Benson Lake SVC Siting

- Bay Lake Certificate of Public Convenience and Necessity (CPCN) Application filed May 2014
  - Two Benson Lake alternatives proposed
    - 'North' alternative
    - 'South' alternative
- Public Service Commission of Wisconsin (PSCW) Order received May 2015
  - 'North' alternative Ordered due to lesser impact on forested wetlands

# Benson Lake SVC Siting



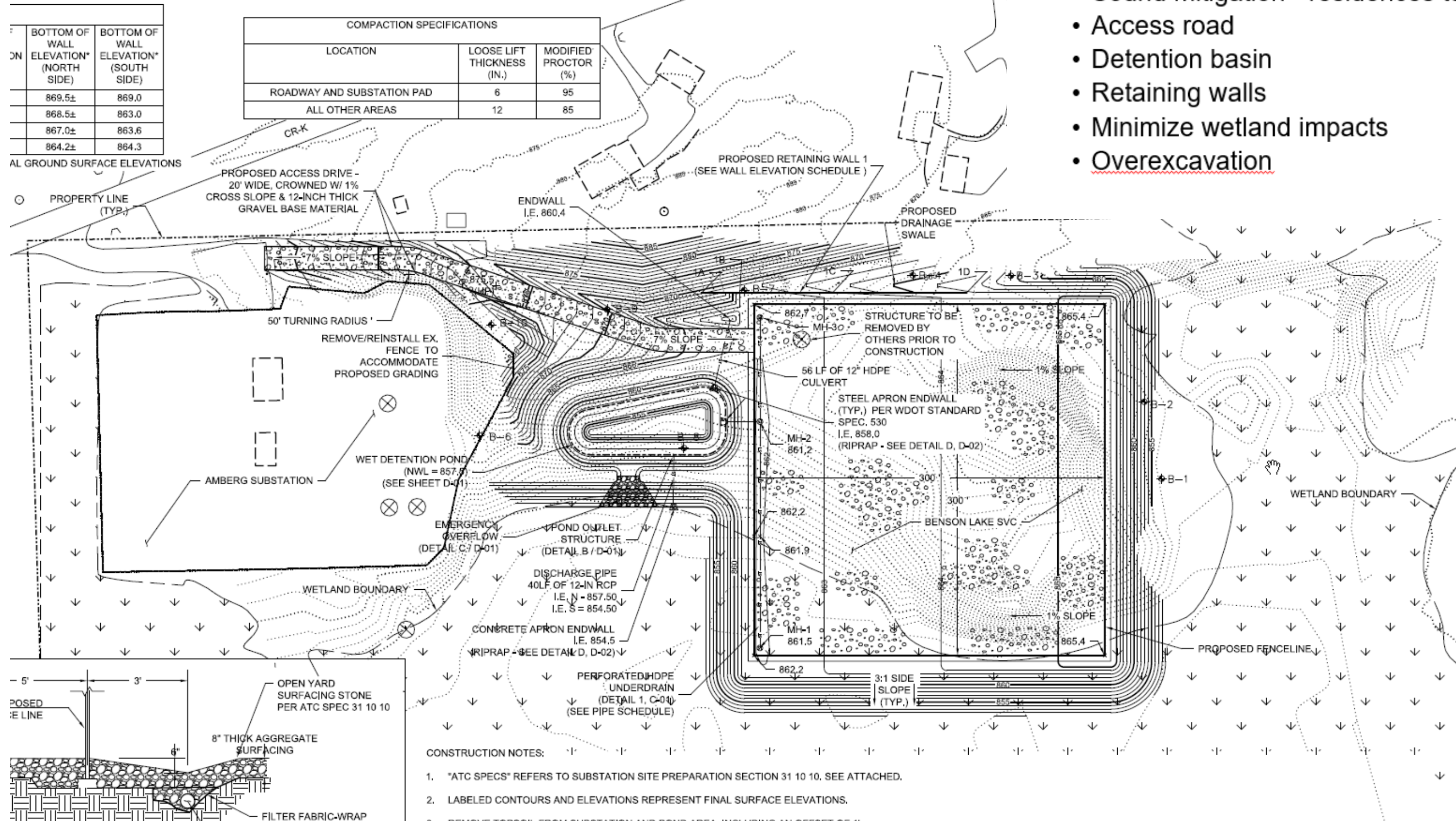
# Benson Lake SVC Contract

- EPC contract to SVC manufacturer for SVC
  - ATC responsible for design and construction of stormwater facilities and all grading/site work
    - AECOM perform design via subcontract with ATC Alliance partner Black & Veatch
- ATC contracted with Black and Veatch
  - Perform system studies
  - Create SVC functional specification
  - Act as Owners Engineer
- October 2014: RFP submitted to 3 bidders
- September 2015: EPC Contract awarded to ABB
  - In-Service date of June 30, 2017

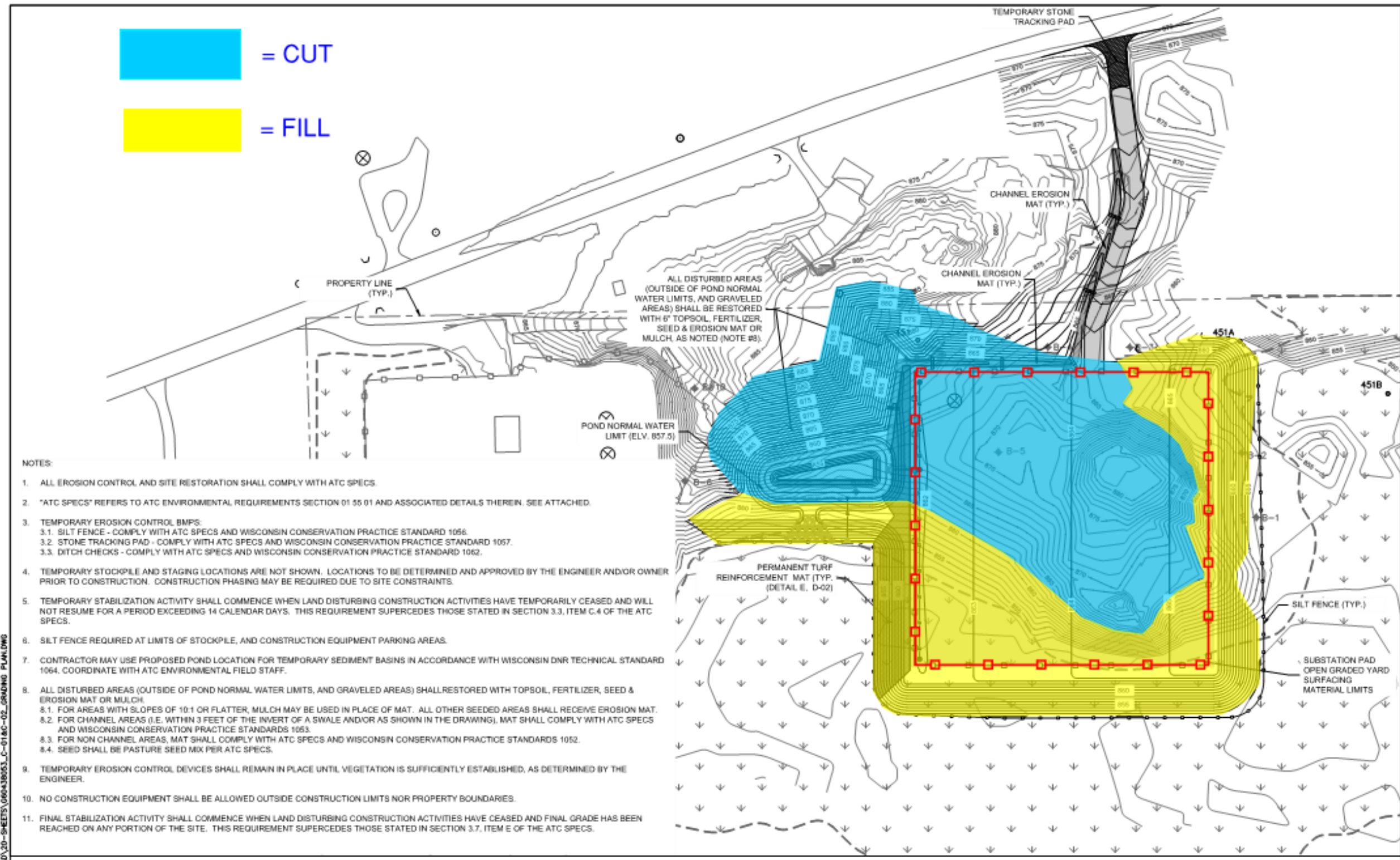


# Benson Lake SVC Site Design

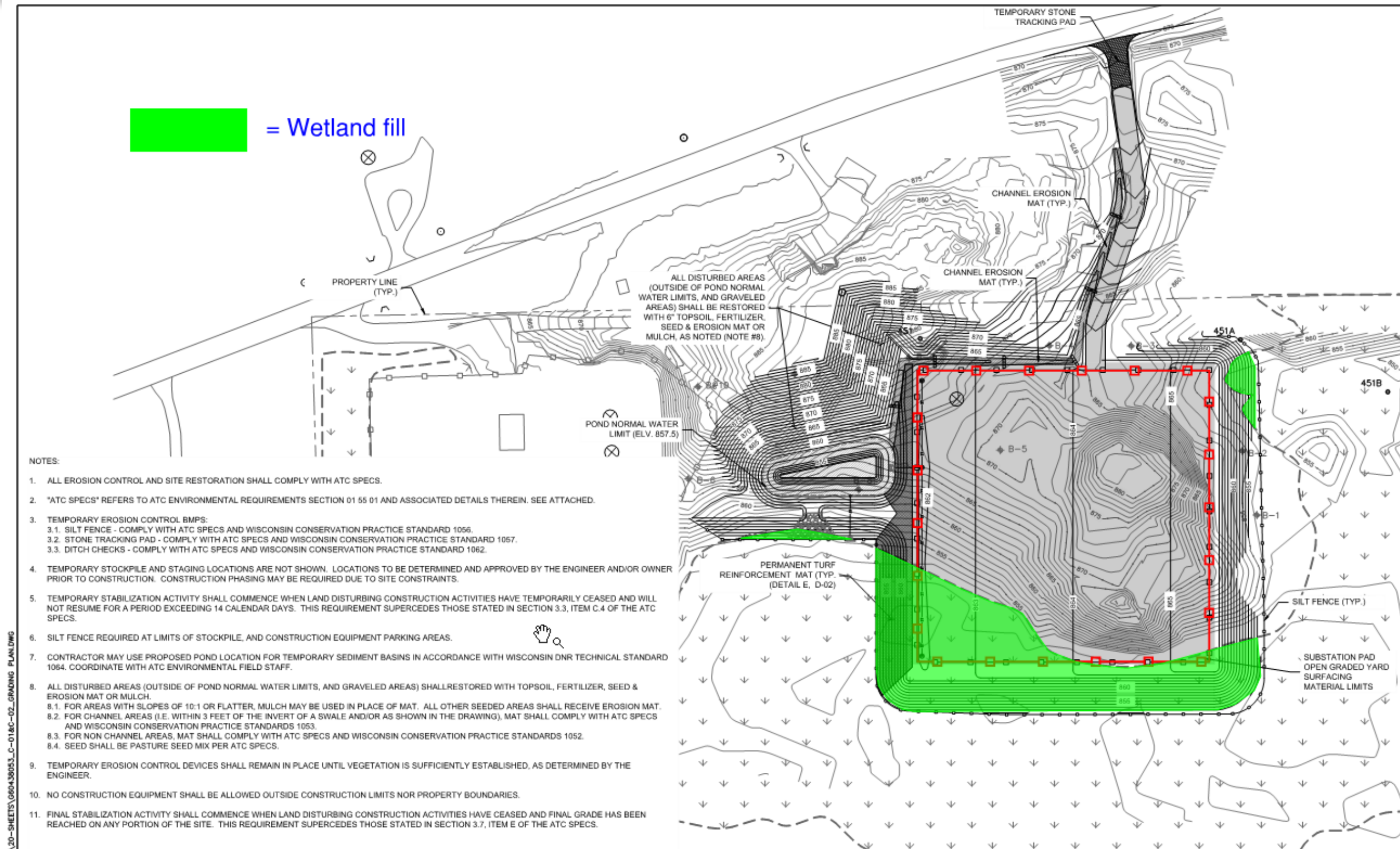
- Design Challenges
  - Rock
  - Existing 138kV circuit relocation
  - Sound mitigation - residences to the North
  - Access road
  - Detention basin
  - Retaining walls
  - Minimize wetland impacts
  - Overexcavation



# Benson Lake SVC Site Design



# Benson Lake SVC Site Design



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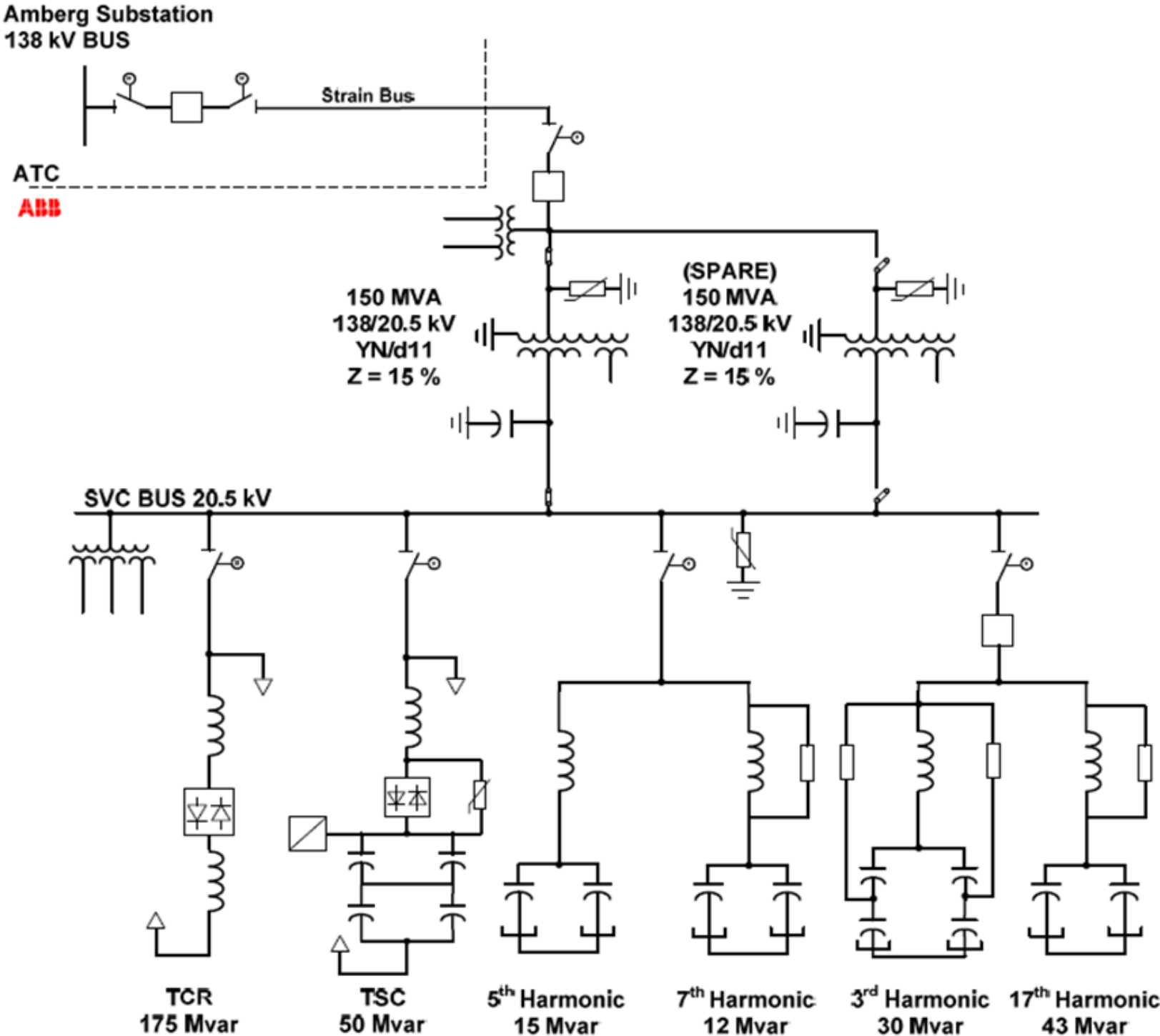
# Benson Lake SVC Interfaces

- Protection of 138kV radial line
  - 411L CD / 311L CD over dedicated fiber
- RTU / Communications interface with ABB MACH2 control system
- Security
- Grounding
- Fiber pathways
- Auxillary AC station service sources

# Benson Lake SVC - Ratings

- Rated for 150 Mvar capacitive and 75 Mvar inductive
- 175 Mvar Thyristor Controlled Reactor (TCR)
- 50 Mvar Thyristor Switched Capacitor (TSC)
- 100 Mvar filters: 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>, and 17<sup>th</sup>/High Pass
- Rated for continuous operation between 0.90 and 1.1 pu voltage on the 138-kV system

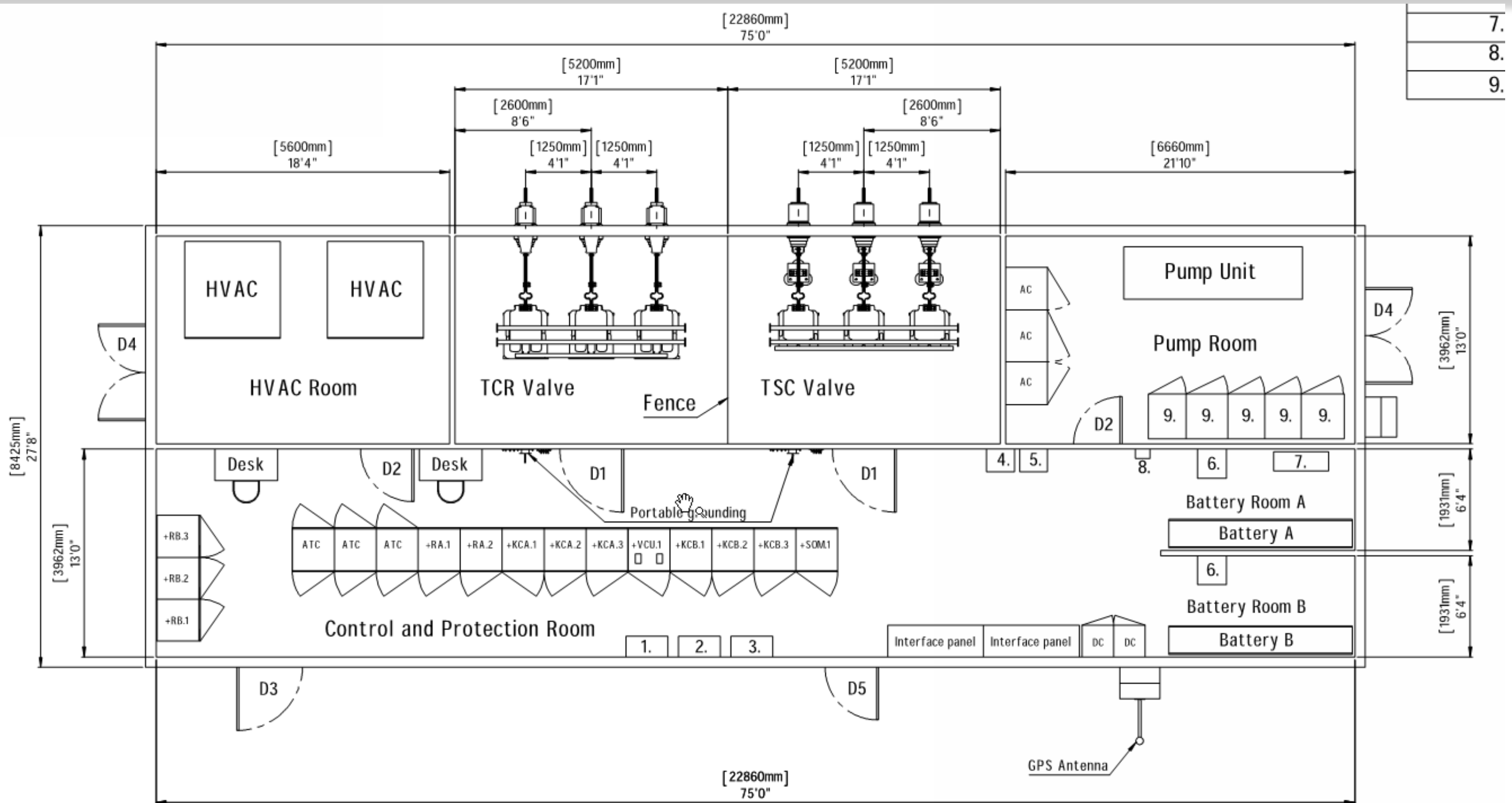
# Benson Lake SVC Single Line Diagram



# Site Layout



# Control Building Layout



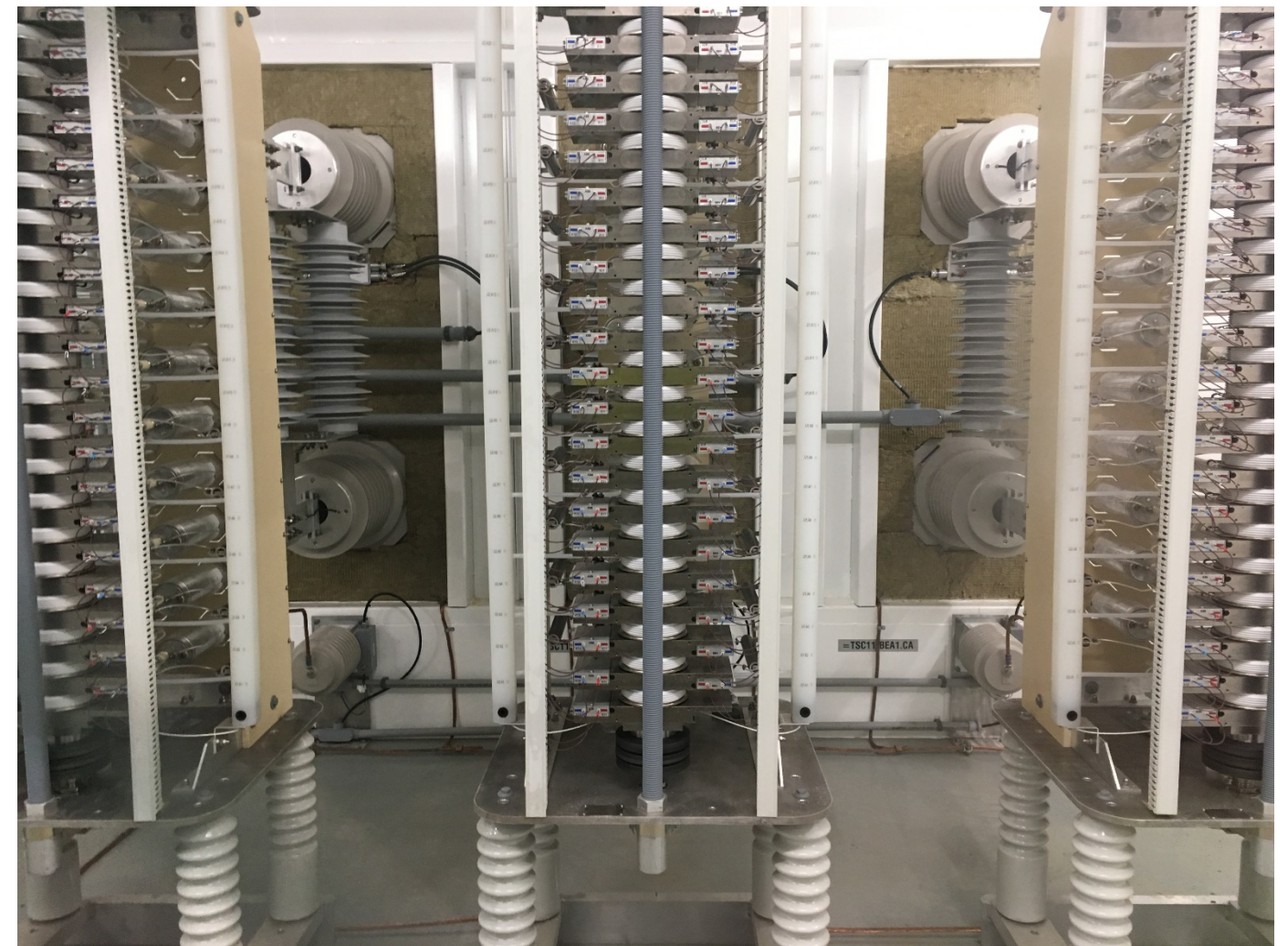


# Thyristors

TCR Valve



TSC Valve



# Cooling System



- Propylene Glycol

# TCR (Thyristor Controlled Reactor)



# TSC (Thyristor Switched Capacitor)



# Filter Banks



# SVC Transformer



# Construction Milestones

- February 2016: Tree Clearing
  - Northern Long-Eared bat restrictions
- August 2016: US Army Corps of Engineers (USACOE) wetland permit received, ATC begins site work
- October 2016: ATC complete rough grading of site
  - Site turned over to ABB

# Benson Lake SVC Construction



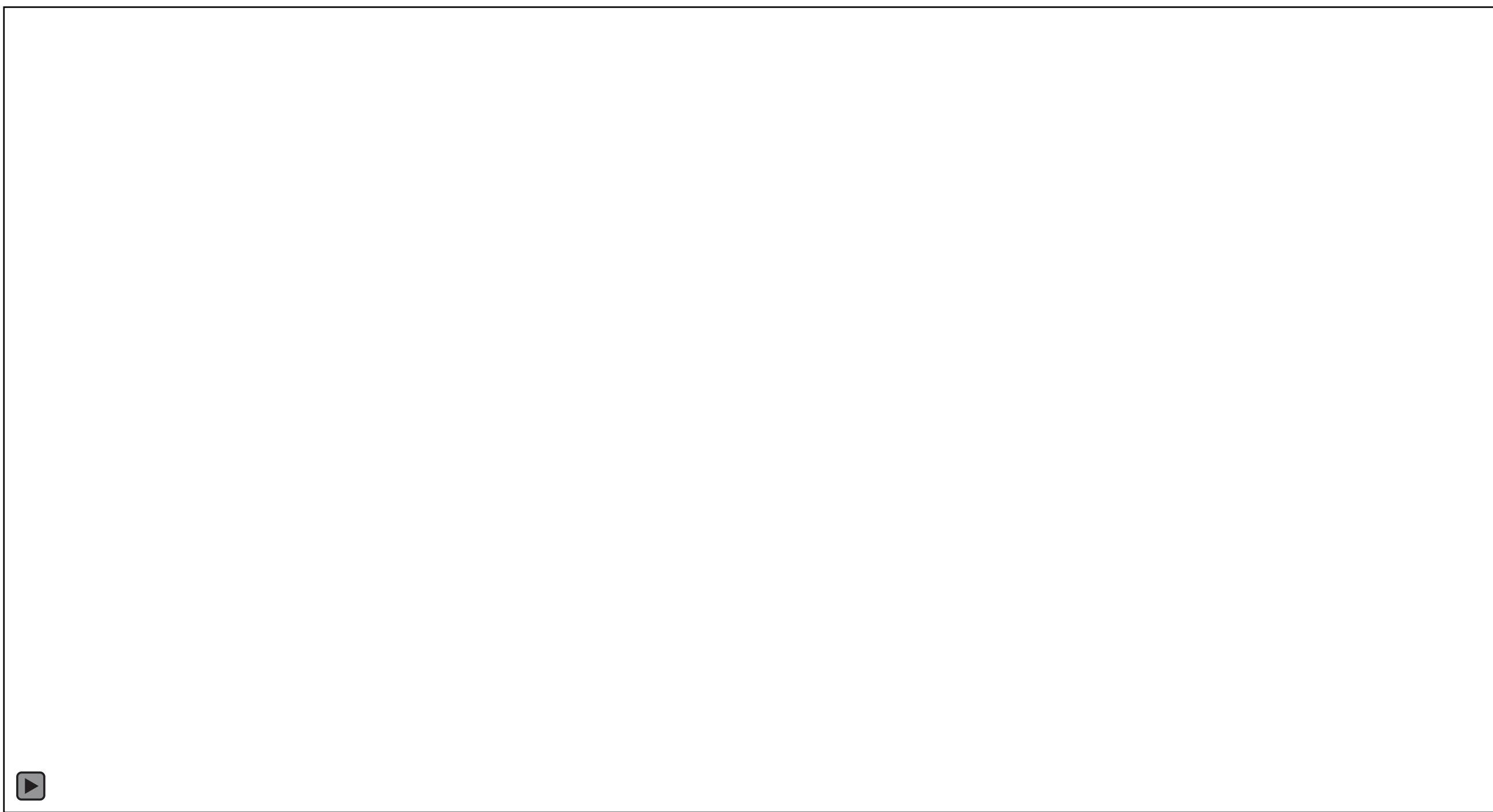


# Blasting the Rock



# Blasting the Rock





# Blasting the rock

- Some Details:
  - 32,000+ cubic feet of rock blasted
  - 54,500+ ton of granite reduced to rubble
  - Over excavated to 3 feet below rough grade
  - Backfilled with 44,500 cubic yards of fill



# Benson Lake SVC

October 19, 2016



November 16, 2016



# Benson Lake SVC

December 13, 2016



January 12, 2017



# Benson Lake SVC

February 9, 2017



March 9, 2017



# Benson Lake SVC

April 7, 2017



May 19, 2017





# Benson Lake SVC

- Commissioning Dates
  - Cold Commissioning: Started approximately March 27, 2017
  - Hot Commissioning: Started approximately April 24, 2017 and concluded with transmission testing May 12.
- Commercial as of June 30, 2017

Thank you!

# Questions?